DOCUMENT RESUME

ED 172 773 IR 007 399

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TITLE Interactive Closed Circuit Television: Educational Implications for the Severely Visually Impaired.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.; Rehabilitation Services Administration (DHEW), Washington, D.C.
PUB DATE 8 Apr 79
CONTRACT 300-75-0123
GRANT RSA-14-P-55846/9
NOTE 31p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, California, April 8, 1979) ; Best copy available

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Closed Circuit Television; *Educational Television; Interaction; *Man Machine Systems; Media Research; *Television Research; *Visually Handicapped

ABSTRACT

Interactive classroom television (ICTS) systems were installed in two special education classrooms to evaluate their impact on the learning experiences of severely visually impaired students. During a 3-year experimental period, data were collected from approximately 14 elementary students measuring achievement, visual-motor integration, visual memory, and relevant social psychological dimensions. Outcomes were examined in within-subject analyses assessing the extent and pattern of change over time. Results indicated significant improvements across measurement areas. Achievement scores approximated grade normal by the final year, suggesting that the experimental system provided educational opportunities comparable to those experienced by the fully sighted. (Author/JVP)

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INTERACTIVE CLOSED CIRCUIT TELEVISION: EDUCATIONAL IMPLICATIONS FOR THE SEVERELY VISUALLY IMPAIRED

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The Rand Corporation

ED172773

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*Prepared for presentation to the American Educational Research Association, San Francisco, California, Session 4.10, April 8, 1979.

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An Interactive Classroom Television System (ICTS) is a way of creating a visual classroom environment for partially sighted students by making use of the magnification, brightness and contrast capabilities of television cameras and monitors. More precisely, an ICTS is a multicamera, multimonitor closed circuit television system linking a series of student desks, a teacher's desk, and a room-viewing camera. Such a system permits teachers and their partially sighted students to be in continuous two-way visual communication with one another (See Fig. 1). Moreover, it allows partially sighted students to function visually in classroom situations that are closely akin to those experienced by their fully sighted peers; that is, they can read ordinary printed matter, look at pictures, write with pen or pencil, do workbook problems, correct each others' papers, see the clock on the wall, draw or paint. Thus, an ICTS constitutes a complex visual aid that enables severely impaired students to make the fullest possible use of their residual vision. This paper presents the results of a three-year demonstration project whose aim was to evaluate the effects of an ICTS on the learning experiences of partially sighted elementary school students in special education programs in two southern California school districts. The assumption underlying the research was that even severely impaired students have residual visual capabilities which, given an appropriate aid, can be put to use to maximize learning and provide educational outcomes comparable to those of the fully sighted.*

*This research was supported by grants from the Bureau of Education for the Handicapped, U.S. Office of Education (contract 300-75-0123) and from the Rehabilitation Services Administration (grant 14-P-55846/9).

SUBJECTS AND PROCEDURES

Students in the two participating special education programs were eligible to take part in the ICTS project: a) if they were partially sighted, i.e., if acuity in the better eye even with corrective lenses did not exceed 20/70 but was better than light perception or projection alone; b) if, given multiple impairments, nonvisual handicaps did not seriously interfere with use of TV controls; and c) if they were nominally assigned to grade levels one through six for enrollment purposes, regardless of actual performance level. Approximately 14 students met these criteria and became subjects in the three-year research project; more than 80 percent were legally blind.

Teachers in the participating special education programs were trained to operate the ICTS and were encouraged to employ ordinary grade-appropriate curricular materials (e.g., texts, work sheets, paper-and-pencil games); however, actual choices of materials and lesson plans were entirely their own. Teachers were required to have their students spend two hours per day using the ICTS for academic instruction in group as well as individualized activities. In addition, they could use the ICTS as much or as little as they pleased in nonacademic activities such as music, art and drama. It was hypothesized that such an ICTS program would significantly improve the learning experiences of the partially sighted subjects in the demonstration.

DATA COLLECTION AND ANALYSIS

Program outcomes for subjects were conceptualized in terms of four areas. Of primary importance was the impact of the ICTS on academic achievement in basic elementary school skills. Basic skills, for the purpose of this evaluation, were restricted to reading and mathematics achievement as measured by appropriate subtests of the Comprehensive Test of Basic Skills (CTBS). A second area of concern was the relationship of the ICTS to visually dependent perceptual-motor processes such as visual motor integration (assessed by the Development Test of Visual Motor Integration, or VMI) and visual memory (assessed by the visual sequential subtest of the Illinois Test of Psycholinguistic Abilities, or ITPA). For the partially sighted

student making use of residual vision by means of an ICTS, these processes are important mediators of information encoding and decoding, and thus could have a substantial influence on learning.

Next the project sought to determine what effect, if any, the ICTS had on self and social attitudes (e.g., self esteem and peer affiliation) thought to be significant in students' school experiences. For this purpose we employed both a verbal self-report instrument (the Self Observation Scales, or SOS) and a symbol manipulation task using geometric shapes and relationships to stand for self and social constructs (the Self Social Constructs Test, or SSCT). The final evaluation domain assessed only during the third project year, was facial affect decoding and encoding. It was supposed that for partially sighted students social competence is in part visually mediated--that the ability accurately to perceive and respond to social stimuli is an important part of psychosocial development which most likely involves successful affect decoding and encoding. The former was measured by the Inter-Person Perception Test (IPPT), while the latter was measured in terms of scores on a facial expression production task devised by Ekman (v. P. Ekman and W. Friesen, Unmasking the Face, Prentice Hall, 1975).

Measures were administered primarily on a pre-post basis each academic year. An exception was achievement testing: because scores are known to change little from spring to the following fall, post-measures collected in one year served as premeasures for the succeeding year unless the student changed test levels. Where possible, scores were represented in terms of age or grade level equivalents and/or their distance from an age or grade normal outcome. Because the number of subjects enrolled in the project during any given year was small and because there was little reason to expect normally distributed data, evaluation outcomes within years were investigated primarily by the use of nonparametric analyses relying only on ordinal properties of scores. Examining pre-to-post changes was of primary interest. For this purpose, Wilcoxen matched-pairs signed-ranks tests (within subjects) were used. Between-subjects comparisons exploring outcome differences as a function of such factors as site or age group (grades one through three versus grades four through six)

were assessed with the Mann Whitney U statistic.

In order to investigate changes within subjects over time, longitudinal analyses were undertaken at the end of the project. For this purpose, data were grouped on the basis of "participation year" for all subjects for whom at least two years of measures were available. Defining participation years I and II as a subject's first and second year of enrollment in the project (independently of calendar year) generated a sufficiently large sample for repeated measures analyses of variance. Longitudinal analyses employ both time of measurement (pre-to-post) and participation year (I and II) as repeated independent factors; where appropriate, such analyses also include grade-or age-group as crossed independent factors.

Results

Discussion of results is organized according to the order in which outcome areas were described above. Achievement evaluation results over the three years of the demonstration generated the following conclusions. First, pre-post comparisons showed ICTS subjects improving significantly in both reading and mathematics each year, as expected. Further, at the end of the first year the following pattern of gains was evident: older students were significantly farther from grade normal in both reading and mathematics than were younger students, an outcome to be expected given the cumulative nature of educational deficits; and all students performed significantly better in mathematics (i.e., scored closer to grade normal) than in reading (see Table 1). We inferred that relative superiority of mathematics scores was attributable to the fact that doing computations requires less scanning than does reading. However, students' scores were systematically inferior to grade normal in both skill areas at the end of the first year. The second year's data revealed a contrasting gains pattern: substantially greater improvement occurred in reading than in mathematics, so that no statistically significant differences remained between scores in the two skill areas; apparently a second year of ICTS experience enabled students to learn

the visual scanning skills requisite for advances in reading achievement (see Table 2). Finally, by the end of the third year of the demonstration, students' achievement scores in both skill areas were not significantly different from grade normal (see Table 3).

Tables 4 and 5 present cell means (N = 17) and values of F with related significance levels for examined sources of variation in reading and mathematics scores studied longitudinally. Table 4 treats reading results as obtained grade equivalent scores (upper half) and as distances between obtained and grade normal scores (lower half); Table 5 is organized similarly. As the analysis summary indicates, reading scores in grade equivalents exhibit a highly significant main effect for pre-post change, a result anticipated on the basis of within-year findings. The average gain was 4.7 months in participation year I and 1 year 6 months in participation year II, or an average gain of 1 year 2.2 months in reading equivalents per year among two-year students. While participation year itself yields no main effect, the change-by-year interaction terms is significant; reading gains are substantially greater in a student's second year, a finding that corroborates within-year conclusions. The analysis of distances between obtained and grade normal reading scores, in contrast, finds no source of variation to significantly influence results. It is interesting to note that while lower-level students' scores tend to be less distant from grade normal (in part reflecting floor effects), it is higher level students whose scores show a net decrease in distance from grade normal over two participation years. Comparable findings come from longitudinal analyses of mathematics scores. As Table 5 indicates, mathematics scores exhibit strong main effects for pre-to-post change across two participation years. Average gain in grade equivalents was 6.8 months in the first participation year and 1 year 1 month in the second, for an average nine-month gain per 10-month school year. Here, however, the change-by-year interaction is not statistically significant. The analysis of distances between obtained and grade normal mathematics scores, like that for reading scores, shows no significant source of variation. It is interesting, nevertheless to note the similar pattern

of mean discrepancies in relation to grade level. That is, while grade level does not yield a main effect, the average discrepancy tends to be smaller for younger than for older students, while older students show more systematic decreases in discrepancy during the two years.

The investigation of the two visually dependent perceptual-motor skill areas yielded an interesting and related pattern of results. With respect to visual-motor integration students' scores showed a significant increase in the first year although at post test they remained substantially behind developmental age norms. Visual sequential memory scores were higher, on average, by the end of the first year as well but not by a statistically significant margin (see Table 6). In contrast, the second year's data manifested just the opposite sorts of results: VMI scores tended in general to increase but not systematically; ITPA visual sequential memory scores, on the other hand, showed strong and significant improvements. It seemed likely that visual-motor coordination increased as students learned to use the ICTS, during the first year of the demonstration. But scanning, as we have seen, was more difficult and apparently required a longer learning period. Thus, visual sequential memory scores (partly dependent on scanning skills) did not evidence significant positive change until the second year, during which reading (also scan-dependent) improved as well (see Table 7). These conjectures were supported by examining intercorrelations among achievement and visually dependent skill scores. While ITPA scores were associated with mathematics achievement, they were much more closely correlated with reading achievement. The third year's outcomes showed further (and significant) gains in VMI scores, with subjects topping out on the ITPA subtest (see Table 8).

Longitudinal results are given in which tables 9 and 10 present cell means and values of F with related significance levels for independent factors expected to influence visual-motor integration and visual sequential memory (N = 17); scores represent age equivalents in months. The analysis summary in Table 9 (upper half) indicates a highly significant main effect for overall rate of pre-post

change in visual-motor integration, an encouraging result since fall-to-spring gains reached statistical significance during only two of the three project years. The average gain in month equivalents was 12.1 for participation year I and 14.2 for participation year II, or an average gain of 13.2 months in developmental equivalents per year in visual-motor integration among two-year students. Dependent measures in the lower half of Table 9 represent distance of obtained scores from age-normal scores in terms of months. Here the rate of change approaches significance, suggesting that students were making strong, stable progress toward developmentally normal performance in visual-motor integration. In addition, age level significantly influenced scores, with older students beginning and remaining much further behind developmental norms than younger students. Longitudinal analysis of VMI scores, then, supported conclusions drawn from within-year data: while students showed improvement across project years, measured both as gains in developmental months and as decreases in distance from age-normal visual-motor functioning, they were unable to eliminate the discrepancy between obtained and developmentally expected scores, with older students being at the most severe disadvantage.

Contrasting findings come from the analyses of visual sequential memory scores. As Table 10 (upper half) indicates, none of the examined sources of variation had a major effect on visual sequential memory. Participation year is the strongest independent factor and approaches statistical significance, suggesting that the second year of ICTS experience was important in promoting visual sequential skills. Outcomes at the end of the second participation year averaged 15.1 months higher than outcomes attained at post-test time 12 months earlier; these findings tend to corroborate interpretations of within-year studies (where only the second project year produced significant gains) and are strengthened by results of the longitudinal investigation of reading and mathematics scores. The examination

of distances between obtained and age-normal scores is summarized in the lower half of Table 10 where only one main effect is evident: older students' visual sequential memory performance was substantially more discrepant with developmental norms than was the performance of younger students. The cell means suggest that gains on age norms are found primarily among the younger students, with older students neither losing ground nor advancing. Consequently, the fact that by the end of the project no significant differences existed between obtained and grade-normal scores was primarily a function of the scores of younger students. These results, together with the longitudinal analysis of VMI scores, suggest that it may be more difficult for students to overcome deficits in perceptual motor skills related to visual impairment than to overcome related achievement deficits. If so, it could be supposed that while perceptual motor skills surely facilitate transfer of academic information and while some level of skill acquisition is requisite for reading and mathematics achievement, age-normal perceptual motor function is not necessary to grade-normal achievement.

The third evaluation area, self and social attitudes, seemed most recalcitrant to change. Two different measurement methods were chosen to assess a set of attitudes thought to be relevant to school success. The experimentally developed Self Social Constructs Test (SSCT), a nonverbal instrument that makes use of spatial symbols and their arrangement to represent self and social schemata, was employed to assess four constructs: self esteem, social distance from teachers and peers, and scope of peer attachment. The second attitude instrument employed, the nationally normed Self Observation Scales (SOS), is a set of verbal yes-no items designed to assess self-acceptance, social maturity, school affiliation, and self security. Results for the two instruments on a within-year basis are presented in Tables 11 through 17. As is evident, school-relevant self and social attitudes did not show positive difference scores over the three years generally commensurate with achievement and related visual skill gains. Specifically, the first year's data yielded no overall significant gains on any psychosocial measure except for social maturity

(SOS), an outcome not specifically associated with the demonstration and probably reflective of normal social development with increasing school experience (Table 11). Somewhat more encouraging results were manifest in the second year's data (Table 12) which yielded significant positive changes in self esteem and peer attachment or affiliation scores (SOS, SSCT) generated by two quite different measurement methods. However, by the third year, only small and inconsistent changes appeared (Table 13): social distance from peers (SSCT) showed a significant decrease, but school affiliation scores (SOS) also yielded a significant decrease. Longitudinal repeated measured analyses essentially corroborate these conclusions. Results for the three self-oriented attitude measures appear in Tables 14 and 15 (upper half). Here it is evident that the strongest source of variation in attitude toward self is grade level, older students exhibiting more favorable self constructs across fairly different measurement methods. Only self acceptance (SOS) also manifests a main effect for pre-post change in a positive direction; in the absence of support from measures of related constructs, however, this outcome is not strongly compelling. Tables 15 (lower half) through 17 present summary tables for repeated measures analyses of socially-oriented measures. As expected, strongest effects for change over time as well as grade level are generated by the social maturity measure (again interpreted as reflecting maturation). School reflective measures, in contrast, show the following results. SSCT measures of peer contact tapping aspects of intimacy and extensiveness show that while closeness to teachers is unaffected by any independent factor, older students seem to have more extensive peer networks and to feel closer to other students during the school year. On the other hand, the SOS measure of school affiliation evidence a decrease over the school year especially among younger students. These findings have led us to three conclusions. First, it would be desirable to locate or develop more sensitive and valid measures of self and social attitudes among handicapped students. Second, it is possible that the history of often-tested severely handicapped students

engenders rather invariant failure expectations with attendant negative self images that are difficult to overcome; we were unable to observe positive changes in self and social constructs commensurate with strong gains in achievement and related visual skills. Finally, it seems particularly important to give special attention to the socioemotional climate for lower-grade visually impaired elementary school students.

The last evaluation domain comprised affect decoding and encoding. This assessment was introduced in the third year of the study on the hypothesis that social perception and social communication might be visually based skills that mediate interpersonal behavior for visually impaired students in somewhat the same way that visual symbolic capability mediates academic activity. If so, then it would be worthwhile to attempt to understand more about the self-social constructs of subjects by assessing hypothetically underlying skills. Table 18 presents within year results for the Inter-Person Perception Test. As is evident, at pretest subjects performed poorly on the facial affect recognition task (IPPT), and no statistically significant overall gains in affect decoding were attained. In part the absence of recognition gains seemed due to the task stimuli. Although every effort had been made to improve the contrast in the standard stimulus photographs for the IPPT, subjects still had difficulty discriminating facial details. While novel test development lay beyond the scope of the project, results from the affect encoding task led us to believe that a better stimulus set would have produced better results. With respect to affect encoding ("making a face" conventionally representative of a specified affect), ICTS subjects scored profoundly worse than matched fully sighted controls (Table 19). However, within a year, subjects had made significant advances so that post test scores compared favorably with the pretest scores of the controls; no significant differences remained between them (Figures 2-6). Because reproduction is usually regarded as more difficult than recognition, we suspect that recognition scores are depressed due to an inadequate measurement method. We believe that affect decoding and encoding among partially sighted students is an area well worth further exploration, particularly

in relation to development of social competence among the visually handicapped.

In summary, three years of evaluation data suggest that the ICTS had a strong and stable positive impact on the learning experiences of partially sighted elementary school students. Effects are most visible in reading and mathematics achievement, where students have closed the gap between their own and grade normal outcomes. The greatest need is for developing methods to enhance self and social constructs, perhaps by using the ICTS to facilitate interpersonal competence. Overall it was our conclusion that the ICTS can be used to maximize the learning opportunities of severely visually impaired students and to provide educational experiences comparable to those of the fully sighted.

Table 1

CTBS SCORES, 1975-1976

Subject	Grade Normal	Reading				Mathematics				Post-test: Reading - Mathematics
		Post-test Score	Distance from Grade Normal	Pre-test Score	Pre-Post Change	Post-test Score	Distance from Grade Normal	Pre-test Score	Pre-Post Change	
Site I										
101	6.9	5.4	-1.5	4.6	+0.8	4.9	-2.0	5.2	-0.3	+0.5
102	5.9	1.8	-4.4	1.5	+0.3	3.7	-2.2	2.9	+0.8	-1.9
103	3.9	3.3	-0.6	3.6	-0.3	4.0	+0.1	3.8	+0.2	-0.7
104	4.9	5.2	+0.3	5.8	-0.6	5.9	+1.0	4.4	+1.5	-0.7
105	1.9	1.5	-0.4	0.6	+0.9	2.1	+0.2	0.5	+1.6	-0.6
Site II										
201	3.9	3.0	-0.9	2.3	+0.7	2.5	-1.4	2.5	±0	+0.5
203	6.9	3.1	-3.8	2.3	+0.8	3.3	-3.6	3.2	±0.1	-0.2
205	1.9	1.8	-0.1	1.0[a]	+0.8	2.7	+0.8	1.0[a]	+1.7	-0.9
210	6.9	2.3	-4.6	2.3	±0	3.6	-3.3	1.6	+2.0	-1.3
Means			-1.8		+0.4		-1.24		+0.8	-0.6

[a]Theoretical beginning first grade score; this student bottomed out on the fall CTBS.

Table 2

CTBS SCORES, 1976-1977

Subject	Grade Normal	Reading				Mathematics				Post-test: Reading - Mathematics
		Post-test Score	Distance from Grade Normal	Pre-test Score	Pre-Post Change	Post-test Score	Distance from Grade Normal	Pre-test Score	Pre-Post Change	
Site I										
102	6.9	2.1	-4.8	1.8	+0.3	4.0	-2.9	3.7	+0.3	-1.9
103	4.9	5.1	+0.2	3.3	+1.8	5.8	+0.9	4.0	+1.8	-0.7
104	5.9	6.1	+0.4	5.2	+1.1	6.7	+0.8	5.9	+0.8	-0.4
Site II										
201	4.9	5.1	+0.2	3.0	+2.1	3.4	-1.5	2.5	+0.9	+1.7
203	7.9	4.8	-3.1	3.1	+1.7	3.0	-4.9	3.3	-0.3	+1.8
210	7.9	3.5	-4.4	2.3	+1.2	4.4	-3.5	3.6	+0.8	-0.9
211	1.9	1.7	-0.2	0.1	+1.6	1.3	-0.6	0.1	+1.2	+0.4
213	4.9	5.7	+0.8	5.5	+0.2	5.1	+0.2	4.0	+1.1	+0.6
214	2.9	1.9	-1.0	1.2	+0.7	1.8	-1.1	0.1	+1.7	+0.1
215	6.9	4.9	-2.0	2.2	+2.7	3.3	-3.6	3.6	-0.3	+1.6
Means			-1.39		+1.34		-1.62		+0.8	+0.2

Table 3

CTBS SCORES, 1977-1978

Subject	Grade Normal	Reading				Mathematics				Post-test: Reading - Mathematics
		Post-test Score	Distance from Grade Normal	Pre-test Score	Pre-Post Change	Post-test Score	Distance from Grade Normal	Pre-test Score	Pre-Post Change	
Site I										
103	5.9	5.4	-0.5	5.1	+0.3	7.1	+1.2	5.8	+1.3	-1.7
104	6.9	7.8	+0.9	6.3	+1.5	6.5	-0.4	6.7	+0.9	+1.3
Site II										
201	5.9	6.9	+0.11	5.1	+1.8	5.7	-0.3	3.4	+2.3	+1.2
204	3.9	0.3	-3.7	0.2	+0.1	0.6	-3.4	0.1	+0.5	-0.3
207	2.9	1.9	-1.1	1.7	+0.2	4.5	+1.7	3.2	+1.3	-2.6
208	2.9	1.6	-1.4	0.1	+1.5	1.6	-1.4	1.2	+0.4	+0.0
210	8.9	5.0	-3.10	3.5	+1.5	5.0	-3.1	4.4	+0.6	+0.0
212	2.9	1.9	-1.1	1.7	+0.2	2.9	-0.1	1.5	+1.4	-1.0
213	5.9	10.0	+4.2	5.7	+4.5	7.0	+1.2	5.1	+1.11	+3.0
215	7.9	6.3	-1.7	4.9	+1.6	5.6	-2.4	3.3	+2.3	+0.7
216	4.9	7.1	-2.3	4.3	+2.10	6.5	+1.7	5.2	+1.3	+0.6
217	4.9	7.1	-2.3	3.4	+3.9	5.7	+0.9	2.8	+2.11	+1.4
Means			-0.2		+1.6		-0.4		+1.3	+0.2

Table 4

LONGITUDINAL READING SCORE ANALYSIS

CTBS READING SCORES (grade equivalents)

Rate of Change	Participation Year I	Participation Year II
Pre	3.2	3.4
Post	3.7	5.0

Source	F	p
Participation Year	.91	n.s.
Rate of Change	14.29	.002
Year X Rate	4.05	.06

DISTANCE BETWEEN OBTAINED AND GRADE NORMAL READING SCORES

Rate of Change	Participation Year I		Participation Year II	
	Grade Level		Grade Level	
	Lower	Higher	Lower	Higher
Pre	-0.2	-2.0	-0.4	-2.1
Post	-0.8	-2.2	-1.0	-1.1

Source	F	p
Participation Year	.01	n.s.
Rate of Change	.12	n.s.
Grade Level	.64	n.s.
Year X Rate	.61	n.s.
Year X Grade	.06	n.s.
Rate X Grade	1.62	n.s.

Table 5

LONGITUDINAL MATHEMATICS SCORE ANALYSIS

CTBS MATHEMATICS SCORES (grade equivalents)

Rate of Change	Participation Year I	Participation Year II
Pre	3.2	3.7
Post	3.9	4.8

Source	F	p
Participation Year	1.15	n.s.
Rate of Change	19.87	< .001
Year X Rate	1.14	n.s.

DISTANCE BETWEEN OBTAINED AND GRADE NORMAL MATHEMATICS SCORES

Rate of Change	Participation Year I: Grade Level Lower	Participation Year I: Grade Level Higher	Participation Year II: Grade Level Lower	Participation Year II: Grade Level Higher
Pre	-0.05	-2.0	-0.6	-1.8
Post	-0.6	-1.9	0	-1.5

Source	F	p
Participation Year	.01	n.s.
Rate of Change	.04	n.s.
Grade Level	1.40	n.s.
Year X Rate	1.79	n.s.
Year X Grade	.01	n.s.
Rate X Grade	.15	n.s.

Table 6

VISUALLY DEPENDENT SKILLS, 1975-1976

Subject	Age (Years-months)	VMI Post-test Score	VMI Distance from Age Normal	VMI Pre-test Score	VMI Pre-Post Change	ITPA[a] Post-test Score	ITPA[a] Distance from Age Normal	ITPA[a] Pre-test Score	ITPA[a] Pre-Post Change	Post-test: VMI-ITPA
Site I										
101	11-7	8-8	-35	7-2	+18	5-4	-75			+40
102	11-3	6-10	-53	6-10	+0	5-7	-68			+15
103	9-2	7-10	-16	6-5	+17	10-5[b]	+15			-31
104	9-10	10-11	+13	7-10	+37	10-5[b]	+ 7			+ 6
105	6-8	5-7	-13	5-0	+ 7	6-10	+ 2			-15
Site II										
201	8-6	6-10	-20	5-10	+12	6-6	-24	8-4	-22	+ 4
203	12-4	9-6	-34	5-6	+48	6-6	-70	7-10	-16	+36
204	6-10	4-1	-33	4-9	- 8	5-7	-15	4-4	+15	-18
205	6-7	7-4	+9	6-5	+11	6-2	- 5	6-2	+ 0	+14
206	6-1	4-9	-16	4-6	+ 3	10-5[b]	+52	4-10	+67	+68
207	5-5	5-3	-2	4-4	+11	5-7	+ 2	6-2	- 7	- 4
208	5-8	4-9	-11	4-4	+ 5	4-10	-10	3-1	+21	- 1
210	11-9	7-10	-47	7-4	+ 6	5-10	-.71	5-7	+ 3	+24
Means			-20		+13		-20		+ 8	

[a]ITPA was not administered to Madison subjects in fall 1976.

[b]Ceiling scores.

Table 7

VISUALLY DEPENDENT SKILLS, 1976-1977

Subject	Age (Years-months)	VMI Post-test Score	VMI Distance from Age Normal	VMI Pre-test Score	VMI Pre-Post Change	ITPA Post-test Score	ITPA Distance from Age Normal	ITPA Pre-test Score	ITPA Pre-Post Change
Site I									
102	12-3	8-7	-44	6-10	+21	5-10	-77	5-7	+ 3
103	10-2	6-5	-45	7-10	-17	10-5	+ 3	10-5+[a]	± 0
104	10-10	11-9	+11	10-11	+10	10-5+[a]	± 0	10-5+[a]	± 0
Site II									
201	9-6	9-6	± 0	6-7	+35	9-6	+ 3	7-3	+30
203	13-4	7-11	-65	7-4[b]	+ 7	6-10	-66	7-10	-12
204	7-10	4-9	-37	4-4	+ 5	6-2	-20	5-7	+ 7
207	6-5	5-3	-14	5-3	± 0	10-5	+48	6-2	+51
208	6-8	6-10	+ 2	5-7	±15	6-2	- 6	4-4	+22
210	12-9	9-4	-41	6-5	+35	7-10	-47	7-3	+ 7
211	7-2	5-0	-26	4-4	+ 8	5-10	-16	4-7	+15
212	6-10	5-0	-22	4-9	+ 3	6-6	- 4	5-7	+11
213	9-10	9-6	- 4	6-7	+35	10-5+	+ 7	6-10	+43
214	8-3	5-0	-39	5-7	- 7	5-10	-29	6-6	- 8
215	11-8	6-10	-58	8-7	-21	10-5+[a]	± 0	9-9	+ 8
Means			-27		+ 9		-15		+13

[a] Ceiling score.

Table 8

VISUALLY DEPENDENT SKILLS, 1977-1978

Subject	Age (Years months)	VMI Post-test Score	VMI Distance from Age Normal	VMI Pre-test Score	VMI Pre-Post Change	ITPA Post-test Score	ITPA Distance from Age Normal	ITPA Pre-test Score	ITPA Pre-Post Change
Site I									
103	11-2	9-4	-22	6-5	+35	10-5+[a]	± 0	10-5	+
104	11-10	12-8	+10	11-9	+11	10-5+[a]	± 0	10-5+[a]	+
107	6-1	4-9	-16	4-1	+ 8	3-4	-33	3-7	- 3
Site II									
201	10-6	11-1	+ 7	9-6	+19	10-5+	+ 0	9-9	+ 8
204	8-10	5-7	-39	4-9	+10	5-10	-36	6-2	- 4
207	7-5	5-7	-22	5-3	+ 4	9-9	+29	10-5	- 8
208	7-8	7-4	- 4	6-10	+ 6	9-9	+25	6-2	+43
210	13-9	6-10	-83	9-4	-30	6-10	-83	7-10	-12
212	7-10	6-0	-22	5-0	+12	6-6	-16	6-6	± 0
213	10-10	9-6	-16	9-6	± 0	10-5[a]	± 0	10-5[a]	+
215	12-8	9-4	-40	6-10	+30	7-3	-65	10-5[a]	-38
216	9-11	6-7	-40	7-2	- 7	10-5[a]	+ 6	10-5	+
217	9-10	7-11	-23	9-6	-19	10-5[a]	+ 7	10-5[a]	+
Means			-24		+ 6		-13		(b)

[a]Ceiling score.

[b]The frequency of positive nonscoreable changes (i.e., changes beyond ceiling) renders mean change infeasible to calculate for the final project year.

Table 9

LONGITUDINAL VISUAL MOTOR INTEGRATION STUDY

VMI SCORES (age equivalents in months)

Rate of Change	Participation Year I	Participation Year II
Pre	73.1	82.4
Post	85.2	96.6

Source	F	p
Participation Year	1.46	n.s.
Rate of Change	14.67	< .001
Year X Rate	.09	n.s.

DISTANCE BETWEEN OBTAINED AND AGE NORMAL VMI SCORES

Rate of Change	Participation Year I		Participation Year II	
	Age Level		Age Level	
	Lower	Higher	Lower	Higher
Pre	-17.0	-41.0	-20.6	-39.6
Post	-17.3	-30.5	-14.2	-31.9

Source	F	p
Participation Year	.00	n.s.
Rate of Change	2.98	.10
Grade Level	5.27	.03
Year X Rate	.006	n.s.
Year X Age	.00	n.s.
Rate X Age	.75	n.s.

Table 10

LONGITUDINAL VISUAL MEMORY STUDY

ITPA SCORES (age equivalents in months)

Rate of Change	Participation Year I	Participation Year II
Pre	76.67	92.17
Post	82.89	98.0

Source	F	p
Participation Year	2.36	.14
Rate of Change	1.69	n.s.
Year X Rate	.002	n.s.

DISTANCE BETWEEN OBTAINED AND AGE NORMAL ITPA SCORES

Rate of Change	Participation Year I		Participation Year II	
	Age Level		Age Level	
	Lower	Higher	Lower	Higher
Pre	-6.8	-39.8	-13.2	-28.1
Post	-10.2	-37.3	-1.8	-40.9

Source	F	p
Participation Year	.08	n.s.
Rate of Change	.01	n.s.
Grade Level	6.31	.02
Year X Rate	1.67	n.s.
Year X Age	.00	n.s.
Rate X Age	1.67	n.s.

Table 11

PSYCHOSOCIAL OUTCOMES, 1975-1976

SELF SOCIAL CONSTRUCTS TEST

Subject	Self-Acceptance			Social Maturity			School Affiliation			Self-Security		
	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change
Site I												
101	65	61	+ 1	53	54	- 1	59	58	+ 1	67	61	+ 6
102	54	60	- 6	54	50	+ 4	59	54	+ 5	46	55	- 9
103	56	63	- 7	55	56	- 1	55	58	- 3	65	66	- 1
104	65	64	+ 1	57	56	+ 1	59	58	+ 1	67	66	+ 1
105	64	48	+16	56	53	+ 3	57	33	+24	67	67	± 0
Site II												
201	57	52	+ 5	56	57	- 1	31	44	-13	63	59	+ 4
203	60	59	+ 1	58	60	- 2	61	59	+ 2	57	57	± 0
204	55	56	- 1	26	24	+ 2	52	56	- 4	25	22	± 3
205	55	38	+17	55	49	+ 6	43	52	- 9	58	46	+12
206	43	41	+ 2	30	24	+ 6	55	43	+12	34	37	- 3
207	40	42	- 2	30	29	+ 1	28	41	-13	46	50	- 4
208	53	53	± 0	39	37	+ 2	46	60	-14	45	48	- 3
210	51	43	± 8	51	41	+10	46	51	- 5	52	45	+ 7
Means	55	52	+ 2.7	48	45	+ 2.3	50	51	- 1.2	53	52	+ 1.0

[a] T-scores: scales are standardized with $\bar{x}$ = 50 and s.d. = 10.

SELF-OBSERVATION SCALES[a]

Subject	Self-Esteem			Social Distance from Students			Social Distance from Teachers			Attachment to Peers		
	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change[a]	Post-test Score	Pre-test Score	Pre-Post Change[a]	Post-test Score	Pre-test Score	Pre-Post Change
Site I												
101	39	38	+ 1	2	7	-5	2	2	± 0	24	24	± 0
102	24	34	-10	7	10	-3	6	3	± 3	23	18	± 5
103	26	27	- 1	9	7	+2	12	4	+ 8	18	21	- 3
104	29	28	+ 1	2	5	-3	2	4	+ 2	24	24	± 0
105	20	23	- 3	8	6	+2	11	10	+ 1	21	23	± 2
Site II												
201	28	20	+ 8	10	4	+6	7	9	- 2	21	14	+ 7
203	39	27	+12	2	5	-3	2	8	- 6	19	5	+14
204	23	33	-10	6	2	+4	5	2	+ 3	2	13	-11
205	34	24	+10	7	2	+5	2	2	± 0	23	3	+20
206	27	37	-10	7	9	-2	6	7	± 1	7	15	- 8
207	34	32	+ 2	3	4	-1	12	2	+10	15	14	+ 1
208	22	23	- 1	2	6	-4	2	5	- 3	16	12	+ 4
210	45	29	+16	2	9	+7	12	10	+ 2	19	18	+ 1
Means	30	29	+ 1.2	5	6	+0.4	6	5	+ 1.3	18	16	+ 2.2
Range	(8-48)			(2-12)			(2-12)			(0-24)		

[a] Negative changes are representative of *decreased* social distance (i.e., favorable change).

Table 12

PSYCHOSOCIAL OUTCOMES, 1976-1977

SELF SOCIAL CONSTRUCTS TEST

Subject	Self-Acceptance			Social Maturity			School Affiliation			Self-Security		
	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change
Site I												
102	60	54	+ 6	59	57	+ 2	60	56	+ 4	58	54	+ 4
103	62	43	+19	57	50	+ 7	43	30	+13	66	69	- 3
104	63	63	0	60	60	0	59	59	0	67	67	0
Site II												
201	58	58	0	51	52	- 1	24	30	- 6	70	71	- 1
203	59	61	- 2	58	48	+10	39	60	-21	55	50	+ 5
204	53	50	+ 3	44	24	+20	40	51	-11	55	30	+25
207	61	49	+12	38	38	0	32	46	-14	52	51	+ 1
208	55	56	- 1	24	27	- 3	51	47	+ 4	36	34	+ 2
210	60	54	+ 6	54	53	+ 1	43	27	+16	56	58	- 2
211	55	48	+ 7	33	28	+ 5	36	36	0	51	37	+14
212	58	49	+ 9	25	38	-13	38	43	- 5	47	60	-13
213	61	55	+ 6	56	54	+ 2	38	41	- 3	63	54	+ 9
214	57	56	+ 1	42	27	+15	50	56	- 6	53	52	+ 1
215	62	57	+ 5	59	49	+10	50	51	- 1	65	56	+ 9
Means	59	54	+ 5.1	47	44	+ 3.9	43	45	- 2.1	57	54	+ 3.6

[a] T-scores: scales are standardized with $\bar{x}$ = 50 and s.d. = 10.

SELF-OBSERVATION SCALES[a]

Subject	Self-Esteem			Social Distance from Students			Social Distance from Teachers			Attachment to Peers		
	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change[a]	Post-test Score	Pre-test Score	Pre-Post Change[a]	Post-test Score	Pre-test Score	Pre-Post Change
Site I												
102	29	26	+ 3	2	4	- 2	6	5	+ 1	17	19	- 2
103	33	24	+ 9	4	7	- 3	6	7	- 1	5	12	- 7
104	31	16	+15	9	2	+ 7	2	2	± 0	24	24	0
Site II												
201	44	32	+12	2	6	- 4	2	12	-10	9	16	- 7
203	29	30	- 1	2	2	± 0	2	2	± 0	24	21	+ 3
204	24	41	-17	5	2	+ 3	8	2	+ 6	3	2	+ 1
207	36	36	0	2	2	± 0	3	2	+ 1	19	22	- 3
208	34	26	+ 8	2	2	± 0	2	2	± 0	24	24	0
210	34	31	+ 3	12	12	± 0	2	12	-10	22	19	+ 3
211	36	28	+ 8	2	2	± 0	2	5	- 3	24	6	+18
212	22	20	+ 2	6	5	+ 1	5	10	- 5	3	4	- 1
213	40	31	+ 9	7	8	- 1	12	9	+ 3	24	21	+ 3
214	48	38	+10	2	2	± 0	2	12	-10	19	9	+10
215	42	27	+15	2	4	- 2	2	2	± 0	24	24	0
Means	34	29	+ 5.4	4	4	- 0.07	4	6	- 2.0	17	16	+ 1.3
Range		(8-48)			(2-12)			(2-12)			(0-24)	

[a] Negative changes are representative of *decreased* social distance (i.e., favorable change).

Table 12

PSYCHOSOCIAL OUTCOMES, 1977-1978

SELF SOCIAL CONSTRUCTS TEST

Subject	Self-Esteem			Social Distance from Students			Social Distance from Teachers			Attachment to Peers		
	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change[a]	Post-test Score	Pre-test Score	Pre-Post Change[a]	Post-test Score	Pre-test Score	Pre-Post Change
Site I												
103	27	30	- 3	5	5	± 0	8	8	± 0	10	19	- 9
104	27	28	- 1	2	2	± 0	2	2	± 0	22	12	+10
107	31	13	+18	2	4	- 2	2	8	- 6	15	12	+ 3
Site II												
201	28	43	-15	3	2	+ 1	7	6	+ 1	13	18	- 5
204	25	25	± 0	4	7	- 3	6	3	+ 3	3	3	± 0
207	43	48	- 5	12	7	+ 5	12	12	± 0	24	24	± 0
208	25	41	-16	2	2	± 0	2	2	± 0	24	24	± 0
210	32	28	+ 4	2	12	-10	12	12	± 0	24	24	± 0
212	23	33	-10	3	6	- 3	8	12	- 4	4	9	- 5
213	30	39	- 9	2	4	- 2	12	12	± 0	18	12	+ 6
215	22	30	- 8	2	7	- 5	2	2	± 0	21	24	- 3
216	35	26	+ 9	2	5	- 3	9	4	+ 5	21	21	± 0
217	28	17	+11	2	3	- 1	7	3	+ 4	12	13	- 1
Means	30	31	- 1.9	3	5	- 1.8	7	7	+ 0.2	16	16	- 0.3
Range	(0-48)			(2-12)			(2-12)			(0-24)		

[a]Negative changes are representative of *decreased* social distance (i.e., favorable change).

SELF-OBSERVATION SCALES[a]

Subject	Self-Acceptance			Social Maturity			School Affiliation			Self-Security		
	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change	Post-test Score	Pre-test Score	Pre-Post Change
Site I												
103	59	57	+ 2	57	54	+ 3	57	35	+22	68	68	± 0
104	63	60	+ 3	62	60	+ 2	53	53	± 0	67	67	± 0
107	46	63	-17	21	44	-23	33	49	-16	33	58	-25
Site II												
201	61	60	+ 1	64	64	± 0	57	57	± 0	64	62	+ 2
204	50	52	- 2	40	30	+10	55	54	+ 1	48	49	- 1
207	61	60	+ 1	54	54	0	52	55	- 3	62	61	+ 1
208	53	59	- 6	52	54	+ 2	55	60	- 5	61	59	+ 2
210	59	53	+ 6	61	63	- 2	54	53	+ 1	64	54	+10
212	54	53	+ 1	33	27	+ 6	31	41	-10	47	53	- 6
213	58	61	- 3	59	59	± 0	38	54	-16	52	67	-15
215	59	62	- 3	62	57	+ 5	54	60	- 6	57	61	- 4
216	60	55	+ 5	54	49	+ 5	40	28	+12	61	56	+ 5
217	52	49	+ 3	58	59	- 1	56	55	+ 1	36	46	-10
Means	56	57	- 0.7	52	52	+ 0.5	49	50	- 2.3	55	58	- 3.1

[a]T-scores: scales are standardized with $\bar{x}$ = 50 and s.d. = 10.

Table 14

LONGITUDINAL STUDY OF SELF ATTITUDES

SELF-ESTEEM (SSCT)

Rate of Change	Participation Year I: Grade Level Lower	Participation Year I: Grade Level Higher	Participation Year II: Grade Level Lower	Participation Year II: Grade Level Higher
Pre	25.8	29.3	34.0	28.5
Post	25.8	36.5	29.2	31.5

Source	F	P
Participation Year	.67	n.s.
Rate of Change	.52	n.s.
Grade Level	2.40	13
Year X Rate	1.4	n.s.
Year X Grade	6.15	.02
Rate X Grade	3.98	.06

SELF-ACCEPTANCE (SOS)

Rate of Change	Participation Year I: Grade Level Lower	Participation Year I: Grade Level Higher	Participation Year II: Grade Level Lower	Participation Year II: Grade Level Higher
Pre	52.5	56.3	52.0	57.0
Post	53.2	58.8	55.8	59.9

Source	F	P
Participation Year	.23	n.s.
Rate of Change	3.51	.08
Grade Level	5.56	.03
Year X Rate	.44	n.s.
Year X Grade	.002	n.s.
Rate X Grade	.03	n.s.

Table 15

LONGITUDINAL STUDY OF SELF-SOCIAL ORIENTATION

SELF-SECURITY (SOS)

Rate of Change	Participation Year I: Grade Level Lower	Participation Year I: Grade Level Higher	Participation Year II: Grade Level Lower	Participation Year II: Grade Level Higher
Pre	50.8	55.5	42.0	62.1
Post	48.5	58.3	47.5	60.1

Source	F	P
Participation Year	.008	n.s.
Rate of Change	.36	n.s.
Grade Level	8.90	.008
Year X Rate	.20	n.s.
Year X Grade	1.33	n.s.
Rate X Grade	.12	n.s.

SOCIAL MATURITY (SOS)

Rate of Change	Participation Year I: Grade Level Lower	Participation Year I: Grade Level Higher	Participation Year II: Grade Level Lower	Participation Year II: Grade Level Higher
Pre	40.2	51.7	29.0	54.5
Post	38.5	55.8	34.8	57.5

Source	F	P
Participation Year	.64	n.s.
Rate of Change	5.07	.04
Grade Level	35.23	.001
Year X Rate	1.56	n.s.
Year X Grade	2.24	.15
Rate X Grade	.38	n.s.

Table 16

LONGITUDINAL STUDY OF ATTITUDES TOWARD PEERS

SOCIAL DISTANCE FROM STUDENTS (SSCT)

Rate of Change	Participation Year I, Grade Level Lower	Participation Year I, Grade Level Higher	Participation Year II, Grade Level Lower	Participation Year II, Grade Level Higher
Pre	4.7	6.8	3.0	5.5
Post	6.0	3.7	3.0	4.4

Source	F	p
Participation Year	1.70	n.s.
Rate of Change	1.24	n.s.
Grade Level	.84	n.s.
Year X Rate	.07	n.s.
Year X Grade	.99	n.s.
Rate X Grade	4.49	.05

SCOPE OF PEER ATTACHMENT (SSCT)

Rate of Change	Participation Year I, Grade Level Lower	Participation Year I, Grade Level Higher	Participation Year II, Grade Level Lower	Participation Year II, Grade Level Higher
Pre	13.0	18.3	14.2	18.4
Post	12.5	22.2	12.5	17.5

Source	F	p
Participation Year	.10	n.s.
Rate of Change	.03	n.s.
Grade Level	4.94	.04
Year X Rate	1.93	n.s.
Year X Grade	.29	n.s.
Rate X Grade	1.47	n.s.

Table 17

LONGITUDINAL STUDY OF SCHOOL ORIENTATION

SCHOOL AFFILIATION (SOS)

Rate of Change	Participation Year I		Participation Year II	
	Grade Level		Grade Level	
	Lower	Higher	Lower	Higher
Pre	50.3	52.3	46.2	47.0
Post	41.7	52.2	38.5	45.0

Source	F	P
Participation Year	1.46	n.s.
Rate of Change	6.22	.02
Grade Level	1.46	n.s.
Year X Rate	.02	n.s.
Year X Grade	.10	n.s.
Rate X Grade	3.65	.07

SOCIAL DISTANCE FROM TEACHERS (SSCT)

Rate of Change	Participation Year I		Participation Year II	
	Grade Level		Grade Level	
	Lower	Higher	Lower	Higher
Pre	6.3	5.0	4.5	6.8
Post	5.7	6.0	5.3	4.3

Source	F	P
Participation Year	.23	n.s.
Rate of Change	.16	n.s.
Grade Level	.00	n.s.
Year X Rate	.12	n.s.
Year X Grade	.23	n.s.
Rate X Grade	.19	n.s.

Table 18

INTERPERSON PERCEPTION TEST, 1977-1978

Subject	Pre-test Score	Post-test Score	Pre-Post Change
Site I			
103	5	3	-2
104	10	10	±0
107	7	3	-4
Site II			
201	17	9	-8
204	3	6	+3
207	5	7	+2
208	9	9	±0
210	8	8	±0
212	7	10	+3
213	10	10	±0
215	14	11	-3
216	8	9	+1
217	16	10	-4
Means	9.2	8.1	-0.9
Range		(0-20)	

Table 19

FACIAL AFFECT PRODUCTION, 1977-1978

Subject (Site II)	Matched Control Score[a]	Pre-test	Post-test	Pre-test Distance from Control	Post-test Distance from Control	Pre-Post Change
201	5.7	2.6	10.6	-3.1	+4.9	+8.0
204	5.4	1.4	7.8	-4.0	+2.4	+6.4
207	9.7	4.3	6.4	-5.4	+3.3	+2.1
208	8.9	3.0	10.5	-5.9	+1.6	+7.5
210	5.6	2.8	8.4	-2.8	+2.8	+5.6
212	9.1	2.5	10.0	-6.6	+0.9	+7.5
213	5.1	1.5	11.0	-3.6	+5.9	+9.5
214	6.3	2.9	8.4	-3.4	+2.1	+5.5
215	7.4	3.3	8.8	-4.1	+1.4	+5.5
216	8.1	3.1	9.3	-5.0	+1.2	+6.2
217	9.2	2.7	11.5	-6.5	+2.3	+8.8
2XX	9.8	4.4	9.9	-5.4	+0.1	+5.5
2YY	6.4	5.4	10.2	-1.0	+3.8	+4.8
Means	7.5	4.0	9.4	-4.4	+2.0	+6.4

Range = 0-12

[a] Control subjects were administered the test only once.

[b] Partially sighted students in Site II not selected as experimental subjects.